UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Implementation of Dynamic Line Ratings) Docket No. RM24-6

COMMENTS OF THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

The California Independent System Operator Corporation (CAISO) submits these comments in response to the Commission's Advance Notice of Proposed Rulemaking (ANOPR) in the above-captioned proceeding.[1] Dynamic line ratings offer the promise of greater reliability and efficiency for transmission operations. In considering any proposed rules to implement dynamic line ratings, the Commission should balance requirements with the ability to reduce congestion on constrained elements of the transmission system. Using dynamic line ratings in transmission operations makes sense when they materially enhance reliability and efficiency of transmission operations. Requiring the blanket use of dynamic line ratings – even through a phased implementation and subject to an exception process as set forth in the ANOPR – may not advance reliability and efficiency in all cases.

In any proposed rule, the Commission should propose rules to allow a targeted deployment of dynamic line ratings. The Commission should consider proposing an initial implementation period between three and five years to allow transmission

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[1] *Implementation of Dynamic Line Ratings,* 187 FERC ¶ 61,201 (2024).

providers ample time to identify transmission lines that may benefit most from dynamic line ratings before proposing to require uniform use of dynamic line ratings.[2] The Commission should not propose that transmission providers use uniform criteria such as a specific congestion threshold to determine where to deploy dynamic line ratings during this initial implementation period. A uniform congestion threshold would be arbitrary when applied to different transmission systems. Instead, the Commission should propose that transmission providers justify the criteria they utilize for deploying dynamic line ratings during the initial implementation period. For example, transmission providers may want to proceed with dynamic line ratings first in situations where they are confident they will realize a cost-benefit threshold over a specified time. The Commission could also consider a proposed rule that requires application of dynamic line ratings to a minimum number of transmission lines during this initial implementation period unless a transmission provider demonstrates that another number is more appropriate. The CAISO appreciates the tension between encouraging targeted deployment, which requires analysis to assess the transmission lines best suited for dynamic line ratings, versus a blanket requirement to implement dynamic line ratings subject to a phase-in and exception process. However, the CAISO believes the former is more manageable and less resource intensive at least during an initial phase of deploying dynamic line ratings *(e.g.* 3-5 years) regardless of whether irradiance, wind velocity, or wind direction informs the dynamic line rating.

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[2] Ideally, the Commission would consider the congestion benefits dynamic line ratings provided during this initial implementation period prior to considering whether to require any blanket use of dynamic line ratings.

As the ANOPR acknowledges, transmission providers are working to enhance systems and operational practices in order to comply with Commission Order No. 881 and integrate ambient adjusted ratings into transmission operations.[3] The CAISO encourages the Commission to consider the timetables for Order No. 881 implementation of various transmission providers in connection with any proposal to require the use of dynamic line ratings. Implementation of dynamic line ratings will leverage the same resources entities are devoting to develop and implement ambient adjusted ratings in transmission operations. In addition, assessing the value of dynamic line ratings in any particular case may depend on congestion relief experienced from the use of ambient adjusted ratings.

At this stage, the CAISO recommends any proposed rule requiring dynamic line ratings not take effect prior to 2028. This effective date will allow time for many transmission providers to complete Order No. 881 implementation activities. It will also provide time to assess initial market outcomes utilizing ambient adjusted ratings as well as allow for coordination among and between transmission owners and the independent system operators (ISOs) and regional transmission operators (RTOs) in which they operate regarding where it makes most sense to deploy dynamic line ratings.

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[3] ANOPR at PP 5-8. The CAISO expects to submit a supplemental compliance filing with Order No. 881 to address various refinements and elements it has identified since its initial compliance filing. The CAISO is also speaking with affected stakeholders about submitting a request for additional time to implement Order No. 881.

I. Any proposed rule should respect the construct under which transmission owners are responsible for the methodology to develop facility ratings and communicate those ratings to their reliability coordinator and transmission provider.

The CAISO supports the construct set forth in North American Electric Reliability Corporation (NERC) Reliability Standard FAC-008-5 – Facility Ratings under which transmission owners are responsible for the methodology to develop facility ratings and communicate those ratings to their reliability coordinator and transmission operator. Any directives requiring dynamic line ratings, whether based on solar irradiance or wind velocity and direction, will require enhancements to these methodologies. In developing any proposed rule that relates to ISO/RTO wholesale markets, the Commission should recognize that ISOs/RTOs receive transmission ratings from transmission owners and then utilize those transmission line ratings in both their look-ahead reliability applications as well as their day-ahead and real-time markets. ISOs/RTOs cannot validate with precision whether any specific line rating is consistent with a transmission owner's rating methodology. The Commission should not propose that ISOs/RTOs include language in their tariffs beyond any rules necessary to coordinate deployment of dynamic line ratings where appropriate during any initial implementation period, receiving and utilizing dynamic line ratings in transmission operations, and any transparency requirements. However, any proposed rule should allow ISOs/RTOs to propose that transmission owners include validation steps related to dynamic line ratings so that transmitted ratings are within a confidence band prior to their use in reliability look-head applications or market processes. In addition, or in the alternative to a proposed transmission tariff rule requiring dynamic line ratings on transmission

lines, the Commission could explore requiring dynamic line ratings through NERC Reliability Standards based on overloads that have occurred on transmission lines subject to those standards.

II. Dynamic line ratings will not enhance the reliability and efficiency of transmission operations in all cases.

The ANOPR preliminarily proposes to require transmission providers to implement dynamic line ratings on all transmission lines to reflect solar heating, based on the sun's position and forecastable cloud cover, and on certain transmission lines to reflect forecasts of wind speed and wind direction.[4] Applying dynamic line ratings on all transmission lines to reflect solar heating, based on the sun's position and forecastable cloud cover may not result in greater reliability or efficiency. For example, some transmission lines within the CAISO system experience congestion during daylight hours when solar photovoltaic resources are generating. Calculating a dynamic line rating for these transmission lines based on solar heating or forecastable cloud cover will not provide any material relief to this congestion. During evening and nighttime hours, the lack of output from solar photovoltaic resources reduces this congestion such that a dynamic line rating reflecting a lack of solar heating may result in no material reliability or efficiency gains. Likewise, applying dynamic line ratings to selected transmission lines based on wind speed and wind direction when those lines are subject to a scheduling limit may not increase the line's rating. The CAISO has certain

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[4] ANOPR at P 81.

transmission lines under its operational control that are subject to a scheduling limit. Applying a dynamic line rating based on wind velocity or direction to these transmission lines may not result in any reliability or efficiency gains if that scheduling limit binds. For these reasons, the CAISO recommends any proposed rule allow for transmission owners and ISOs/RTOs to coordinate during an initial implementation period to identify transmission lines on which dynamic line ratings can realize reliability and efficiency gains.

In any proposed rule, the Commission should recognize the need to balance expected reliability and efficiency gains with increased inefficiencies arising from the variance between day-ahead and real-time market operations and settlements. To the extent possible, the CAISO seeks to keep the day-ahead and real-time market aligned to mitigate for differences that can have a detrimental impact in the operation and settlements of the market. Upon Order No. 881 implementation, the CAISO will utilize hourly ratings reflecting current weather conditions. These hourly ratings will, in some cases, increase the variance between the system topology used in the day-ahead market and real-time markets for a specific hour. The application of dynamic line ratings could further result in additional variances. Use of different system topologies across market process may result in different transmission constraints in real-time than those used to clear the day-ahead market. These differences can result in a different profile and severity of congestion, which in turn can result in unintended arbitrage opportunities, affecting market efficiency. Of course, in some cases, dispatch reliability and efficiency will outweigh modeling concerns between the day-ahead and real-time. This fact underscores why the CAISO urges any proposed rule allow for transmission

owners and ISOs/RTOs to coordinate during an initial implementation period to identify those transmission lines on which it makes sense to deploy dynamic line ratings to realize market and efficiency gains.

III. The Commission should consider that meteorological variables such as irradiance and wind velocity and direction have degrees of uncertainty.

The ANOPR preliminarily finds that solar heating based on the sun's position under a clear sky and forecastable cloud cover as well as wind velocity and direction affect thermal ratings of transmission lines.[5] The ANOPR preliminarily finds transmission providers can integrate these meteorological variables into transmission line ratings. Any proposed rule should recognize that meteorological models have multiple variables. Order No. 881 already incorporates temperature, including heat or lack thereof, into transmission line ratings. It is unclear how much additional reliability and efficiency gains will result from factoring solar heating as well as wind speed and wind velocity into transmission line ratings. The Commission should let Order No. 881 implementation play out to help inform where best on the transmission system to deploy dynamic line ratings based on solar heating and wind speed and direction.

In addition, dynamic line ratings will need to factor uncertainty into forecasts of irradiance and wind velocity/direction and therefore dampen the effectiveness of dynamic line ratings. Based on meteorological variables in forecasting supply and demand within the Western Interconnection, the CAISO observes that irradiance and

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[5] ANOPR at PP 18-24.

wind speed and direction can have uncertainty.[6] The CAISO provides information concerning solar forecast accuracy and wind forecast accuracy through a market performance and planning forum it regularly holds.[7] This information includes the mean absolute percentage error (MAPE), which measures accuracy of the CAISO's forecast data and reflects uncertainty association with the production of energy. Similar uncertainties may inform the correlation between irradiance, wind speed, wind direction and transmission line ratings. An important element the CAISO has learned from renewable forecasting is that data quality of real-time sensors is critical for forecasting models. If dynamic line ratings require sensors, the Commission must factor in a plan and relevant costs to ensure maintenance and data quality monitoring.

The ANOPR recognizes that forecast uncertainty exists and may inform line ratings but does not consider such uncertainty in the proposed process to identify transmission lines on which to deploy dynamic lines ratings. In some cases, forecast uncertainty may dampen the effectiveness of any dynamic line rating. Accordingly, the CAISO urges that any proposed rule should allow for transmission owners and ISOs/RTOs to consider both solar and wind forecast uncertainty in their assessment of where to deploy dynamic line ratings in order to enhance the reliability and efficiency of transmission operations.

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[6] The ANOPR suggests transmission providers can forecast solar heating during a clear-sky day with certainty. (ANOPR at P 86.) The CAISO questions this preliminary finding regarding irradiance during clear-sky days.

[7] *See e.g.* presentation for September 18, 2024 Market Performance and Planning Forum at slides 154-157: https://www.caiso.com/documents/presentation-market-performance-and-planning-forum-sep-18-2024.pdf

IV. The Commission should allow – at least for an initial period - a targeted deployment of dynamic line ratings rather than a blanket requirement with an exception process.

The ANOPR proposes transmission providers integrate the impact of solar heating on transmission line ratings within 12 months. The ANOPR proposes a phased-in implementation for transmission lines subject to a wind requirement based on a congestion threshold. The CAISO opposes both of these preliminary proposals. Instead, the Commission should direct transmission providers to identify those transmission lines where application of dynamic line ratings based on solar heating, wind speed and wind direction may help achieve reliability and efficiency gains and implement those ratings for an initial period (*e.g.* 3- 5 years). This initial period will provide a valuable opportunity to assess the effectiveness of dynamic line ratings based on assumptions used by transmission providers. The Commission could require reporting in connection with these deployments and any observed reliability or efficiency gains. Thereafter, the Commission could require a more comprehensive deployment of dynamic line ratings. In the case of ISOs/RTOs, this initial implementation timeframe would allow for participating transmission owners to work with their respective ISO/RTO to identify transmission elements where dynamic line ratings may provide the most value.

With respect to how to assess where reliability and efficiency gains may be most meaningful, potential indicators such as volumetric congestion and/or shadow prices reflecting that congestion could be appropriate criteria. And yet the use of congestion as a criteria to deploy dynamic line ratings requires context. Transmission providers

should also consider the volume of load subject to this congestion. For example, if the overwhelming majority of CAISO load clears in the day-ahead market with no congestion and congestion were to occur in the real-time market then the use of dynamic line ratings would have a limited impact in the total cost of serving load.

As the Commission is aware, the CAISO schedules energy from participating resources optimally through a security constrained economic dispatch in the day-ahead market based on a modeled transmission network. The system topology of the CAISO controlled grid may change after the day–ahead market and in any fifteen-minute market interval due to outages. In addition to the use of congestion or shadow prices as a trigger for deploying dynamic line ratings, transmission providers may also need to consider the underlying system topology. Potential savings from reducing congestion during normal operations may differ from savings from reducing congestion during periods with planned outages or with combinations of planned and forced outages**.** The CAISO has transmission lines under its operational control for which it needs to consider various all-lines-in-service and outage scenarios pursuant to established operating procedures. These examples may offer targeted opportunities to deploy dynamic line ratings to help manage the congestion impact of planned and forced outages or may dampen the impact any dynamic line rating could have on reliable and efficient transmission operations.

For these reasons, the CAISO strongly believes there is value in proposing a targeted implementation rather a blanket implementation at least for an initial period (e.g. 5 years). The Commission should identify but not necessarily prescribe criteria for transmission providers to use that may inform analysis to determine whether it is

appropriate to apply dynamic line ratings to an individual transmission line as well as a systematic process and periodic timetable for reporting on whether using a dynamic line rating resulted in any reliability or efficiency gains. Reliability criteria may include reduction in thermal overloads or increased transfer capability during stressed conditions. Efficiency gains may include the magnitude of congestion on a transmission line, the frequency of that congestion, the season and hours in which that congestion arises, and the expected reliability and efficiency gains from deploying a dynamic line rating based on solar heating and wind speed and direction after considering ambient adjusted ratings to that transmission line. During an initial implementation period (3 to 5 years), the Commission should provide flexibility for transmission providers to explain the rationale for deploying dynamic line ratings on the transmission lines they choose to do so and require appropriate reporting to ensure adequate transparency.

V. The CAISO supports leveraging Order No. 881 processes to implement any proposal requiring dynamic line ratings.

Based on the directives of Order No. 881, transmission providers are building systems and processes to integrate hourly ratings and any proposed rule needs to leverage those systems and processes and allow adequate implementation time for required changes to those systems or processes. For ISOs/RTOs, these directives include developing functionality to consume dynamic line ratings on an hourly basis. The ANOPR preliminarily proposes that ISOs/RTOs leverage Order No. 881 implementation to implement dynamic line ratings.[8] The CAISO supports this approach.

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[8] ANOPR at P 5-8.

From a technical perspective, ISOs/RTOs should be able to leverage their Order No. 881 systems and processes to integrate dynamic line ratings into day-ahead and real-time markets. Similar to ambient adjusted ratings, the Commission should consider ensuring that any dynamic line ratings submitted to ISOs/RTOs should include some mechanism to ensure that line ratings are accurate or fall within an expected range. The CAISO plans to build such a feature into its Order No. 881 implementation processes as well as rules to fall back to alternative ratings if a submitted rating falls outside an expected range.

VI. Conclusion

The ANOPR preliminary proposes to require transmission providers to implement dynamic line ratings on all transmission lines to reflect solar heating, based on the sun's position and forecastable cloud cover. The ANOPR preliminarily proposes transmission providers implement dynamic line ratings on certain transmission lines –to reflect forecasts of wind speed and wind direction. In any proposed rule requiring dynamic line ratings, the Commission should balance requirements with the ability to reduce congestion on constrained elements of the transmission system. To allow time for Order No. 881 implementation to occur, the Commission should consider proposing an initial implementation period between three and five years starting no earlier than 2028

to allow transmission providers to identify transmission lines that may benefit most from dynamic line ratings before proposing to require uniform use of dynamic line ratings.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service lists in the above-referenced proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California, this 15th day of October 2024.

/s/ Ariana Rebancos

Ariana Rebancos